Ripple Voltages out of the MicroBooNE HV Power Supply

Sarah Lockwitz and Hans Jostlein September 15, 2014

We measured the Voltage out of one of the two Glassman model LX150 N 12 power supplies to be used for the MicroBooNE TPC drift field.
The measurements were done directly at the end of the Glassman-supplied 8 ft HV cable. No filter pot was used.

We used a Textronix model P6015 HV probe.
The probe attenuates the signal by 1000 X, and loads the source with 100 MOhm.

All quoted voltages are as measured.
Thus , e.g., a 2 mV signal corresponds to a 2 Volt signal , attenuated by the probe.

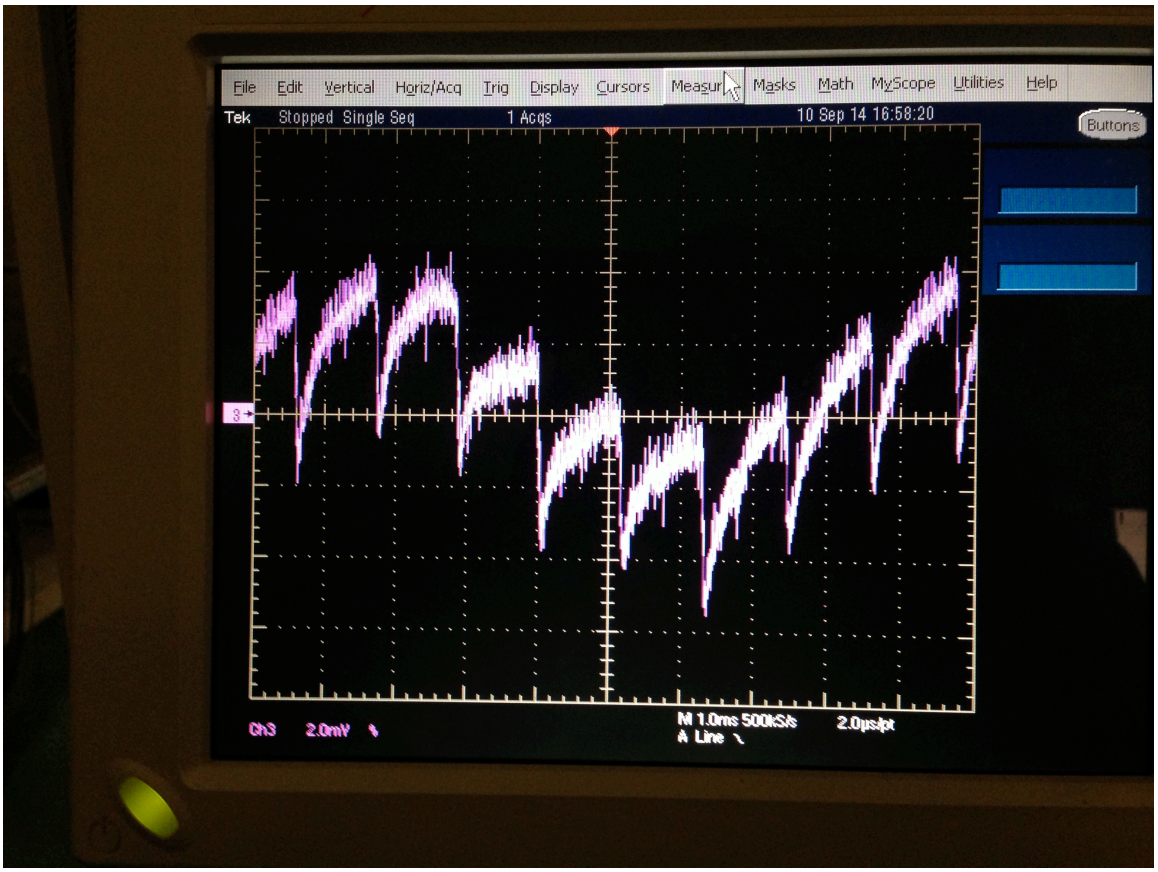
The maximum voltage is 12 kV; we went to 5 KV (50 microamp) and 10 kV (100 microamp). We find the noise at the two voltages essentially indistinguishable. Thus any voltage or current dependence is small.
We show 3 pictures at each of the two high voltages, taken at very different time base speeds.

The slow sweep pictures show baseline wave of 8 mV peak-to-peak with a period of about 8 msec (120 Hz), superimposed with a fast pattern (1 msec, 1 kHz) which is not synchronized with line. The 120 Hz wave can be reasonably understood as a consequence of the single phase power to the HVPS; At peaks and valleys of the 60 Hz fee3d, the switching circuit has more voltage to work with then near zero voltage crossings.

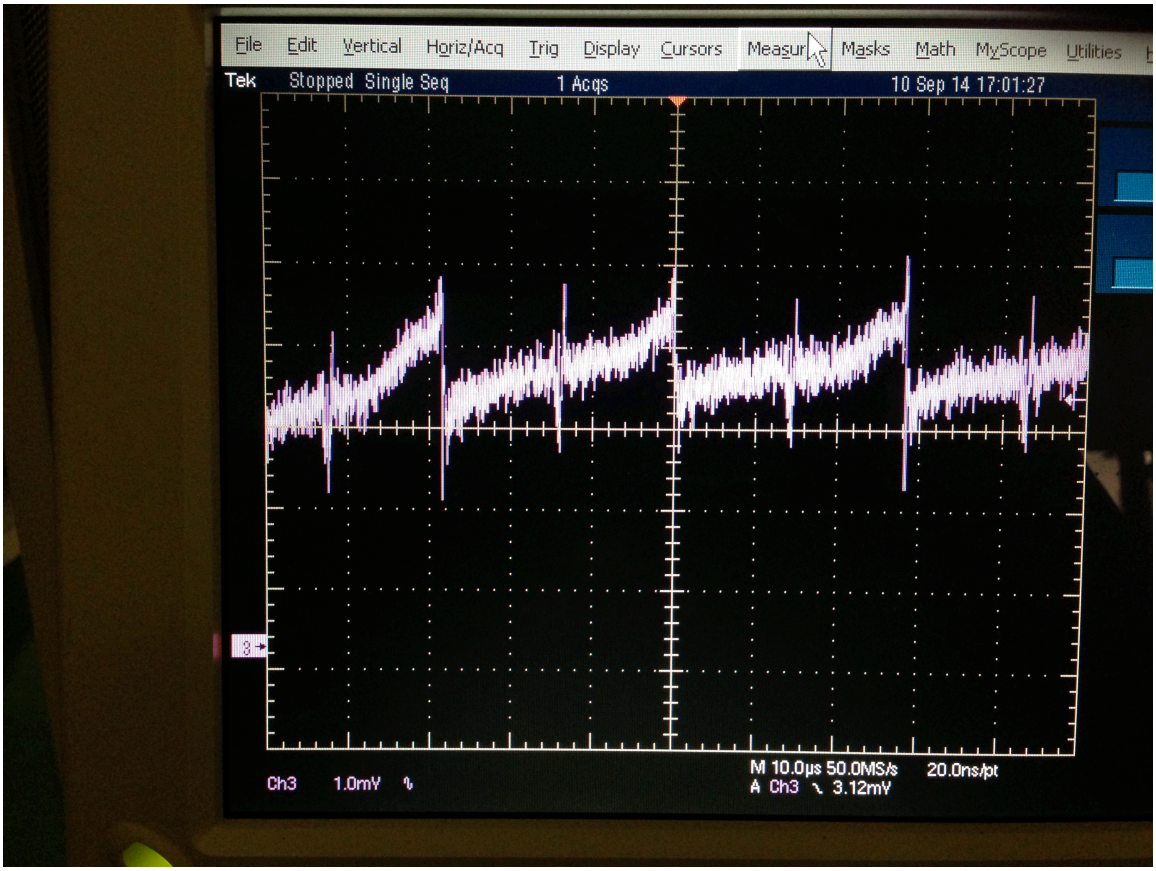
On a faster time scale (10 microsec/inch) we see a recurring pattern at 28 microsec spacing (36 kHz).
(This is, BTW, the same frequency we saw on the older LX125 HVPS that Lariat will be using. The ripple voltages are, however, smaller on the newer Microboone HVPS)

From the 10 microsec/inch sweep pictures (which are the most relevant ones for the TPC noise) we see a noise of about 1.5 mV (1.5 V before probe attenuation) peak-to-peak.

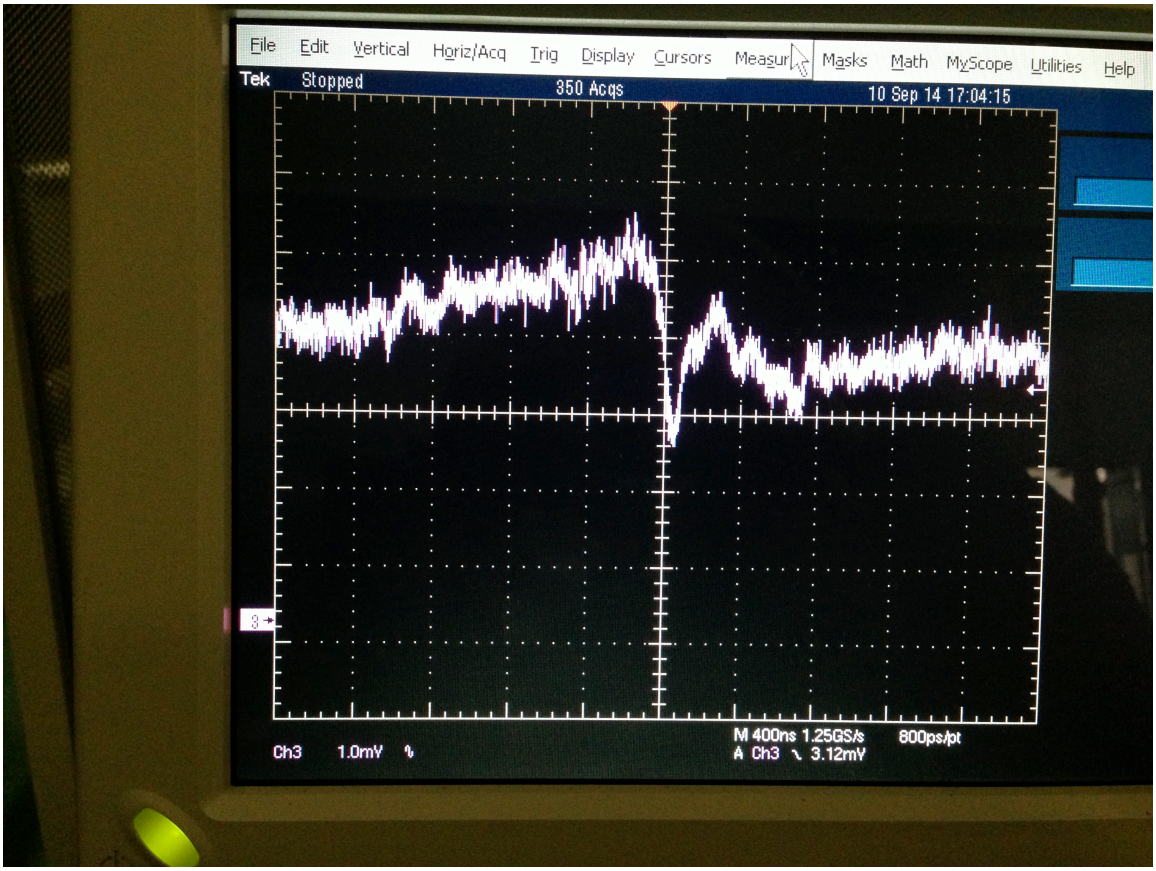
This comparable to the quoted spec of
Ripple: <0.03% of rated voltage + 1V RMS at full load (0.1% for 150 kV),
which would predict 3V = 1 V= 4 V at 10 kV , full (12 mA) current.



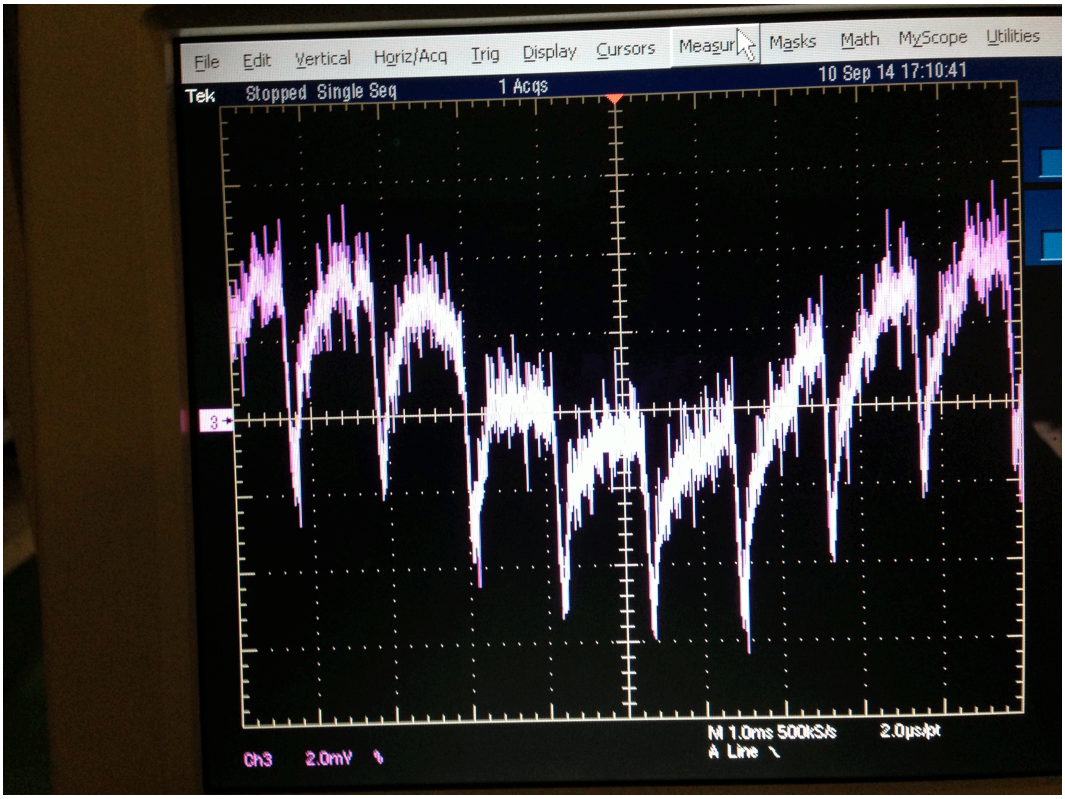
HV at 5 kV, 50 microamps
Scope at 2 mV/inch, 1 msec/inch, line trigger
The 1.3 msec feature is not synchronized with line.



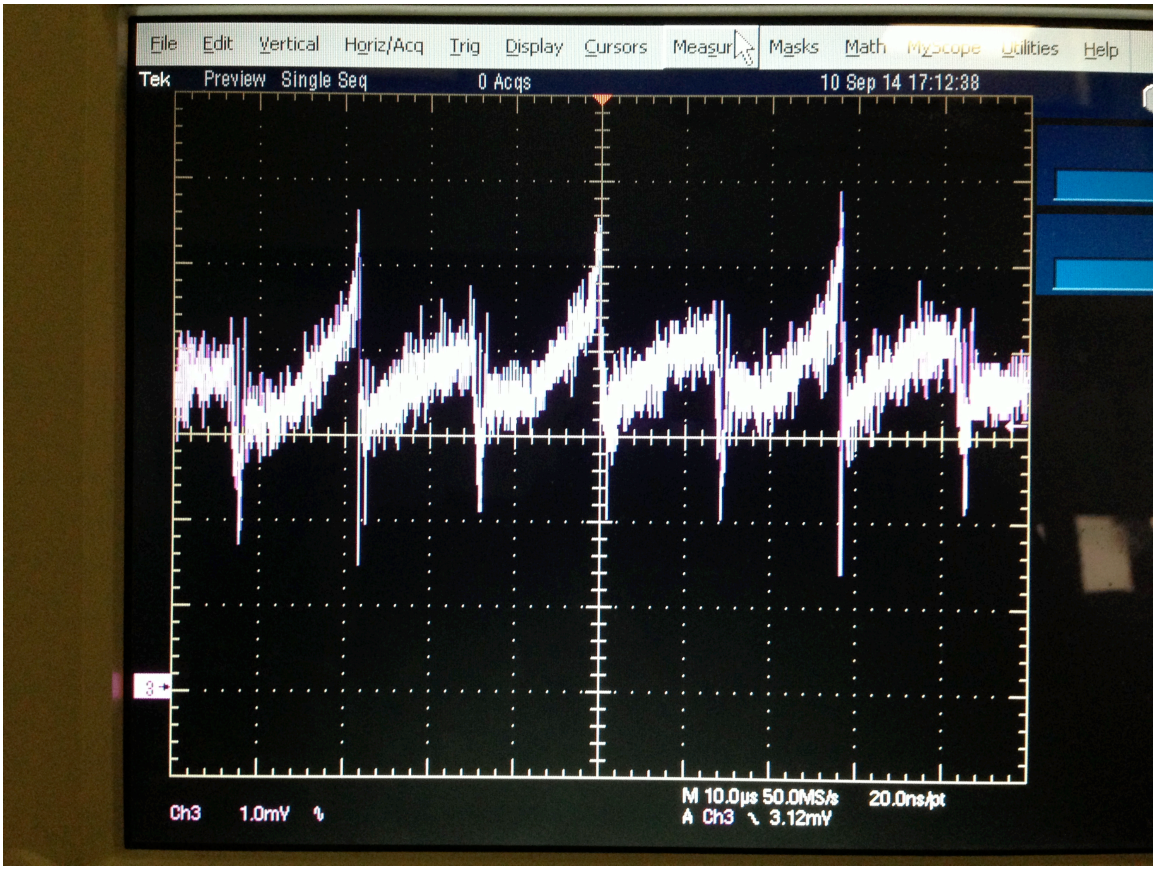
HV = 5 kV, current = 50 microamps
Scope 1 mV/inch, 10 microsec/ inch
Pattern repeats after 28.5 microsec or so (35 kHz)



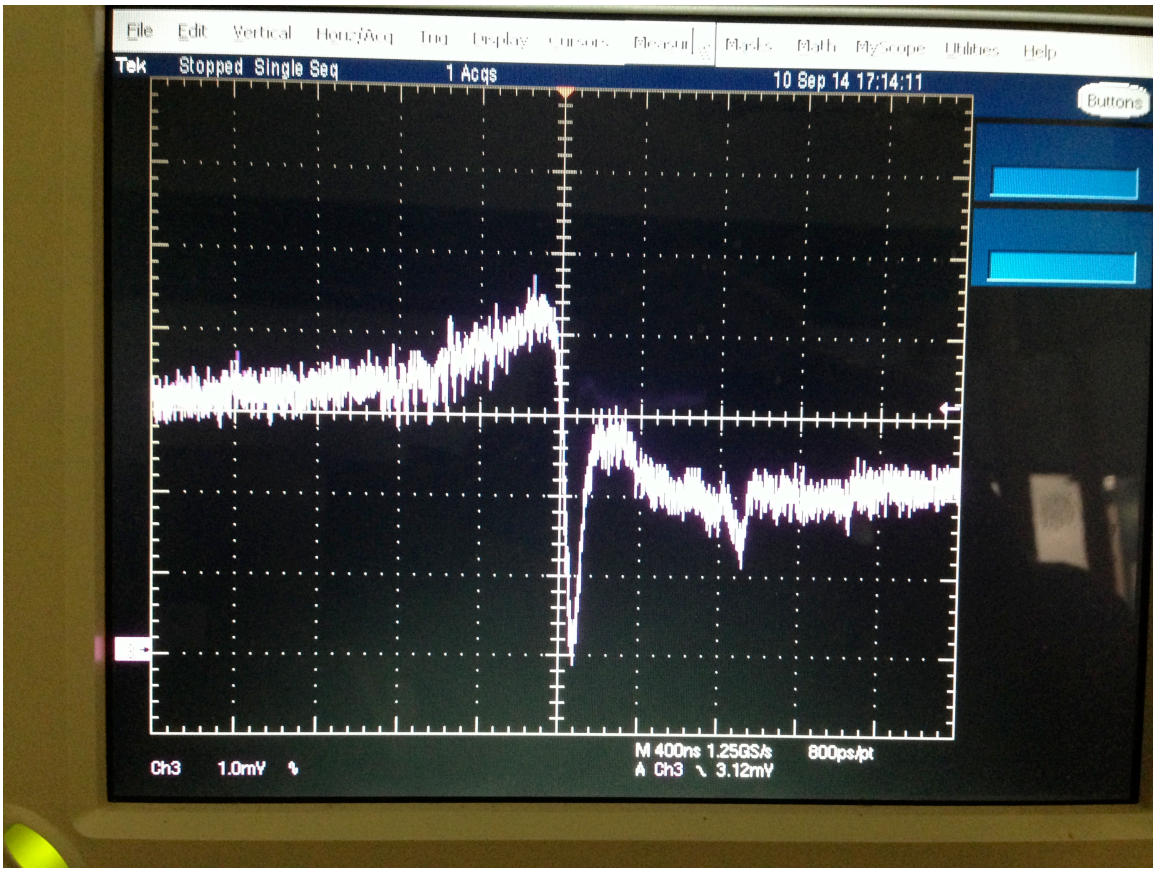
831=796; HV = 5 kV; i=50 Microamp
Scope 1 mV/inch; 400nsec/inch



Pic 832=798
HV = 10 kV; i=100 microamp
Scope 2 mV /inch, 1 msec/inch



Pic 835=801
HV = 10 kV; i=100 microamp
Scope 1 mV/inch; 10 msec/



Pic 837=803
HV = 10 kV; i=100 microamp
Scope 1 mV/ inch; 400 nsec/inch